

# Plastic Medium-Power Complementary Silicon Transistors

... designed for general-purpose amplifier and low-speed switching applications.

- High DC Current Gain —  
 $hFE = 2500$  (Typ) @  $I_C = 4.0$  Adc
- Collector-Emitter Sustaining Voltage — @ 100 mAdc  
 $V_{CEO(sus)} = 60$  Vdc (Min) — TIP120, TIP125  
= 80 Vdc (Min) — TIP121, TIP126  
= 100 Vdc (Min) — TIP122, TIP127
- Low Collector-Emitter Saturation Voltage —  
 $V_{CE(sat)} = 2.0$  Vdc (Max) @  $I_C = 3.0$  Adc  
= 4.0 Vdc (Max) @  $I_C = 5.0$  Adc
- Monolithic Construction with Built-In Base-Emitter Shunt Resistors
- TO-220AB Compact Package

## \*MAXIMUM RATINGS

Rating	Symbol	TIP120, TIP125	TIP121, TIP126	TIP122, TIP127	Unit
Collector-Emitter Voltage	$V_{CEO}$	60	80	100	Vdc
Collector-Base Voltage	$V_{CB}$	60	80	100	Vdc
Emitter-Base Voltage	$V_{EB}$		5.0		Vdc
Collector Current — Continuous Peak	$I_C$		5.0		Adc
Base Current	$I_B$		120		mAdc
Total Power Dissipation @ $T_C = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$		65		Watts
			0.52		$\text{W}/^\circ\text{C}$
Total Power Dissipation @ $T_A = 25^\circ\text{C}$ Derate above $25^\circ\text{C}$	$P_D$		2.0		Watts
			0.016		$\text{W}/^\circ\text{C}$
Unclamped Inductive Load Energy (1)	$E$		50		mJ
Operating and Storage Junction, Temperature Range	$T_J, T_{stg}$		–65 to +150		$^\circ\text{C}$

## THERMAL CHARACTERISTICS

Characteristic	Symbol	Max	Unit
Thermal Resistance, Junction to Case	$R_{\theta JC}$	1.92	$^\circ\text{C}/\text{W}$
Thermal Resistance, Junction to Ambient	$R_{\theta JA}$	62.5	$^\circ\text{C}/\text{W}$

(1)  $I_C = 1$  A,  $L = 100$  mH, P.R.F. = 10 Hz,  $V_{CC} = 20$  V,  $R_{BE} = 100$   $\Omega$ .

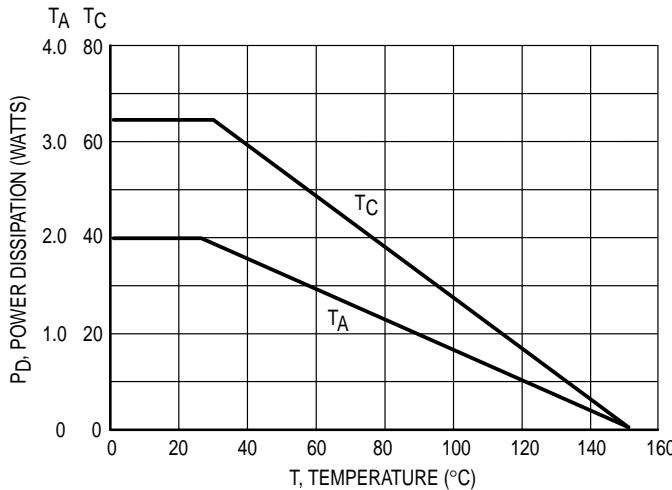


Figure 1. Power Derating

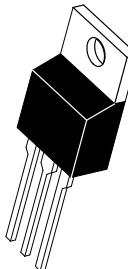
Preferred devices are Motorola recommended choices for future use and best overall value.

REV 2

NPN  
**TIP120\***  
**TIP121\***  
**TIP122\***  
PNP  
**TIP125\***  
**TIP126\***  
**TIP127\***

\*Motorola Preferred Device

DARLINGTON  
5 AMPERE  
COMPLEMENTARY SILICON  
POWER TRANSISTORS  
60–80–100 VOLTS  
65 WATTS

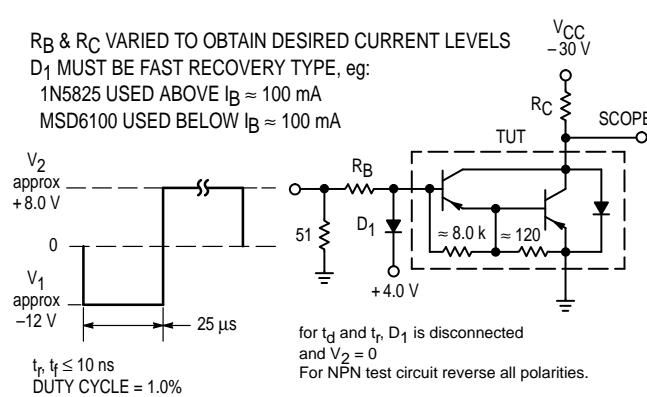


CASE 221A-06  
TO-220AB

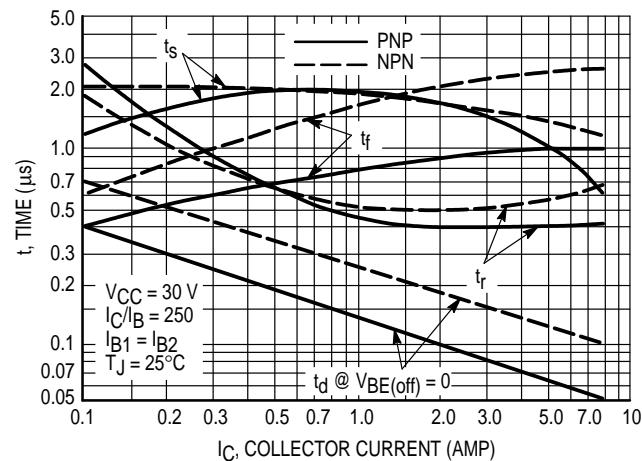
**ELECTRICAL CHARACTERISTICS (T<sub>C</sub> = 25°C unless otherwise noted)**

Characteristic	Symbol	Min	Max	Unit
<b>OFF CHARACTERISTICS</b>				
Collector-Emitter Sustaining Voltage (1) (I <sub>C</sub> = 100 mA, I <sub>B</sub> = 0)	V <sub>CEO(sus)</sub>	60 80 100	— — —	Vdc
Collector Cutoff Current (V <sub>CE</sub> = 30 Vdc, I <sub>B</sub> = 0) (V <sub>CE</sub> = 40 Vdc, I <sub>B</sub> = 0) (V <sub>CE</sub> = 50 Vdc, I <sub>B</sub> = 0)	I <sub>CEO</sub>	— — —	0.5 0.5 0.5	mA
Collector Cutoff Current (V <sub>CB</sub> = 60 Vdc, I <sub>E</sub> = 0) (V <sub>CB</sub> = 80 Vdc, I <sub>E</sub> = 0) (V <sub>CB</sub> = 100 Vdc, I <sub>E</sub> = 0)	I <sub>CBO</sub>	— — —	0.2 0.2 0.2	mA
Emitter Cutoff Current (V <sub>BE</sub> = 5.0 Vdc, I <sub>C</sub> = 0)	I <sub>EBO</sub>	—	2.0	mA
<b>ON CHARACTERISTICS (1)</b>				
DC Current Gain (I <sub>C</sub> = 0.5 Adc, V <sub>CE</sub> = 3.0 Vdc) (I <sub>C</sub> = 3.0 Adc, V <sub>CE</sub> = 3.0 Vdc)	h <sub>FE</sub>	1000 1000	— —	—
Collector-Emitter Saturation Voltage (I <sub>C</sub> = 3.0 Adc, I <sub>B</sub> = 12 mA) (I <sub>C</sub> = 5.0 Adc, I <sub>B</sub> = 20 mA)	V <sub>CE(sat)</sub>	— —	2.0 4.0	Vdc
Base-Emitter On Voltage (I <sub>C</sub> = 3.0 Adc, V <sub>CE</sub> = 3.0 Vdc)	V <sub>BE(on)</sub>	—	2.5	Vdc
<b>DYNAMIC CHARACTERISTICS</b>				
Small-Signal Current Gain (I <sub>C</sub> = 3.0 Adc, V <sub>CE</sub> = 4.0 Vdc, f = 1.0 MHz)	h <sub>fe</sub>	4.0	—	—
Output Capacitance (V <sub>CB</sub> = 10 Vdc, I <sub>E</sub> = 0, f = 0.1 MHz)	C <sub>ob</sub>	— —	300 200	pF

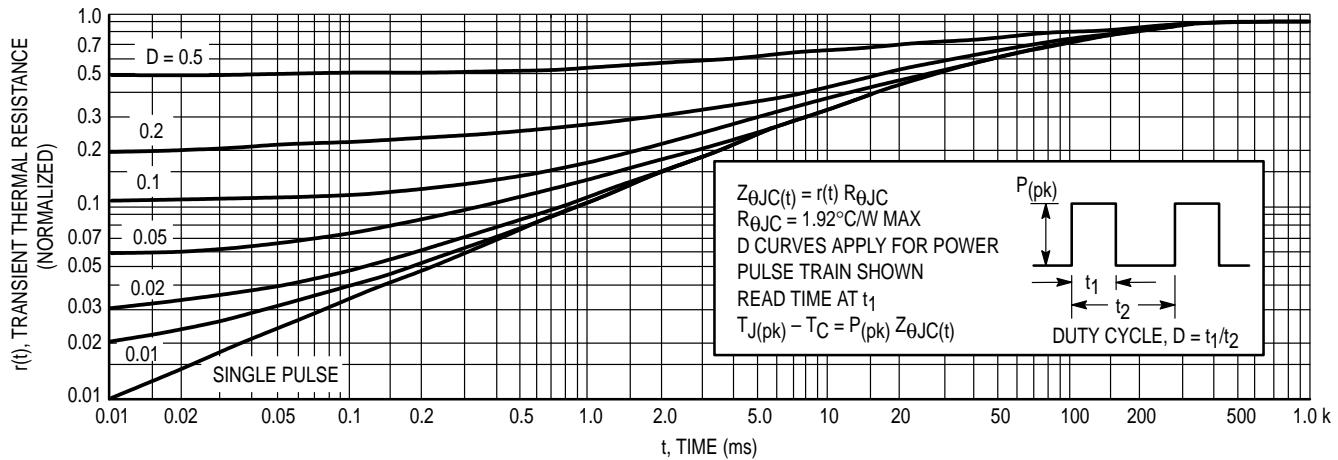
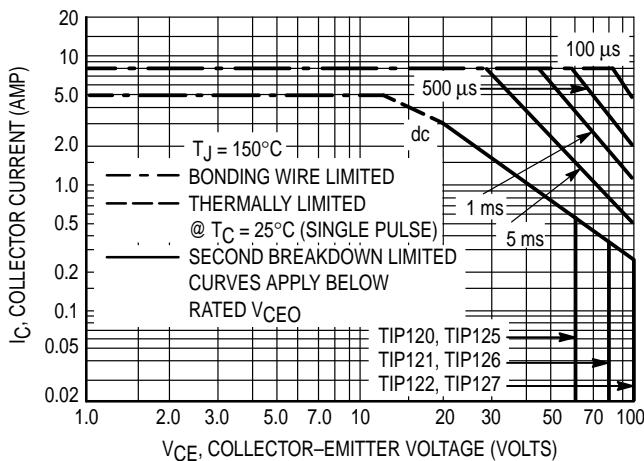
(1) Pulse Test: Pulse Width  $\leq$  300  $\mu$ s, Duty Cycle  $\leq$  2%.



**Figure 2. Switching Times Test Circuit**

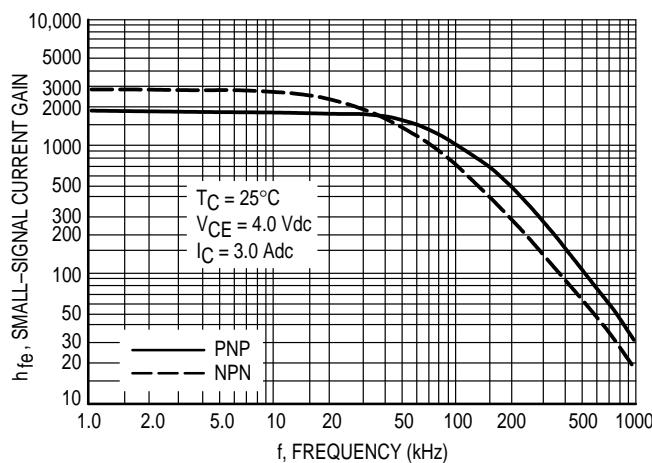
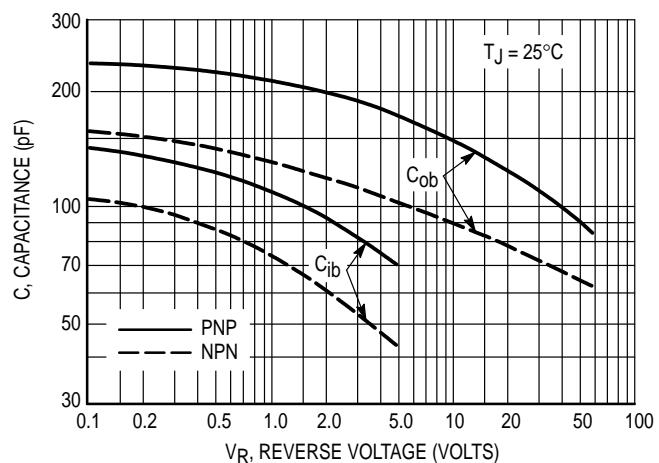


**Figure 3. Switching Times**


**Figure 4. Thermal Response**

**Figure 5. Active-Region Safe Operating Area**

There are two limitations on the power handling ability of a transistor: average junction temperature and second breakdown. Safe operating area curves indicate  $I_C - V_{CE}$  limits of the transistor that must be observed for reliable operation, i.e., the transistor must not be subjected to greater dissipation than the curves indicate.

The data of Figure 5 is based on  $T_{J(pk)} = 150^{\circ}\text{C}$ ;  $T_C$  is variable depending on conditions. Second breakdown pulse limits are valid for duty cycles to 10% provided  $T_{J(pk)} < 150^{\circ}\text{C}$ .  $T_{J(pk)}$  may be calculated from the data in Figure 4. At high case temperatures, thermal limitations will reduce the power that can be handled to values less than the limitations imposed by second breakdown


**Figure 6. Small-Signal Current Gain**

**Figure 7. Capacitance**

**TIP120 TIP121 TIP122 TIP125 TIP126 TIP127**

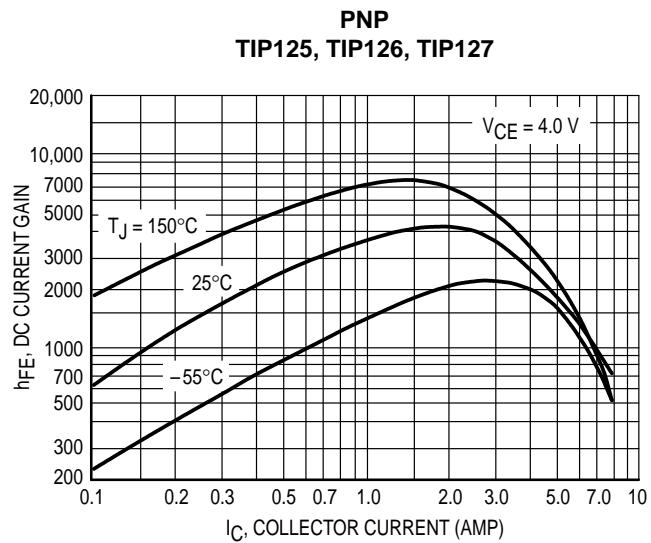
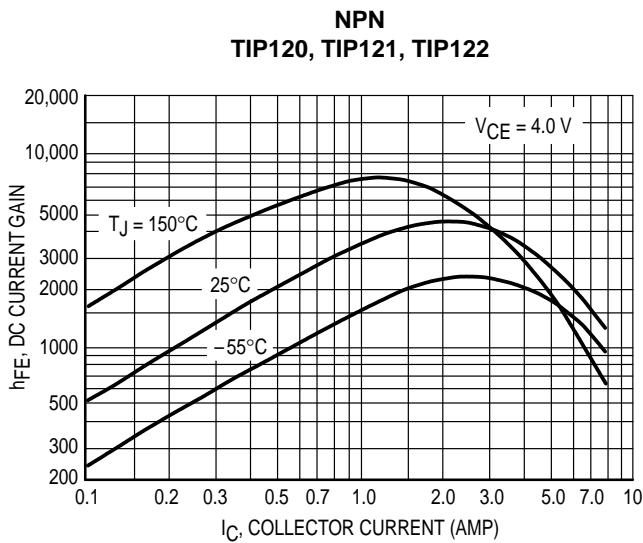


Figure 8. DC Current Gain

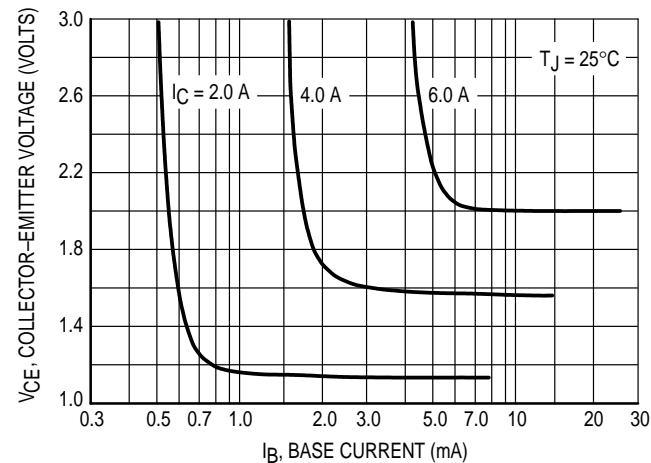
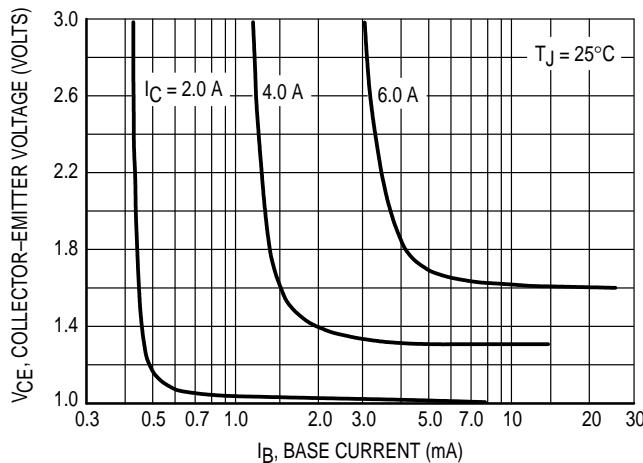


Figure 9. Collector Saturation Region

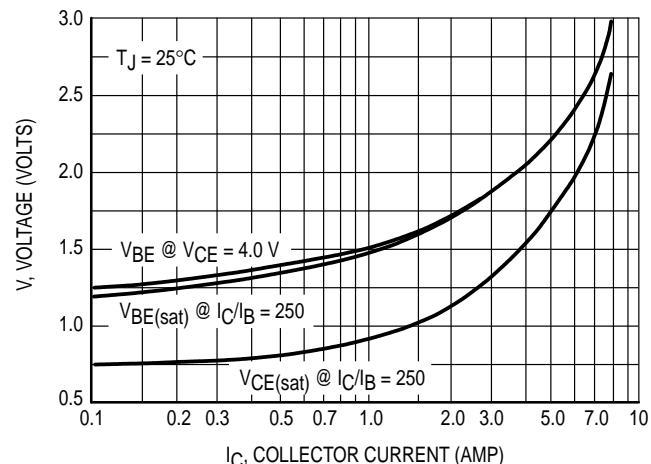
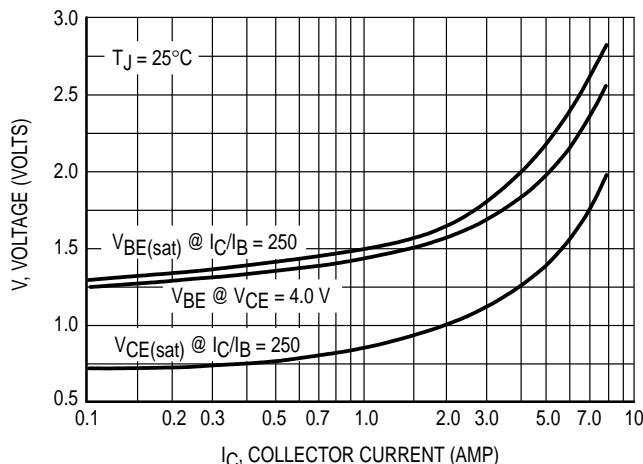
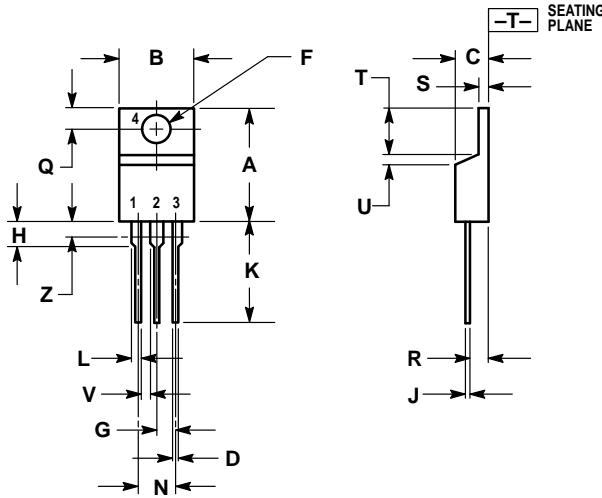


Figure 10. "On" Voltages

## PACKAGE DIMENSIONS



NOTES:  
 1. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.  
 2. CONTROLLING DIMENSION: INCH.  
 3. DIMENSION Z DEFINES A ZONE WHERE ALL BODY AND LEAD IRREGULARITIES ARE ALLOWED.

DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.570	0.620	14.48	15.75
B	0.380	0.405	9.66	10.28
C	0.160	0.190	4.07	4.82
D	0.025	0.035	0.64	0.88
F	0.142	0.147	3.61	3.73
G	0.095	0.105	2.42	2.66
H	0.110	0.155	2.80	3.93
J	0.018	0.025	0.46	0.64
K	0.500	0.562	12.70	14.27
L	0.045	0.060	1.15	1.52
N	0.190	0.210	4.83	5.33
Q	0.100	0.120	2.54	3.04
R	0.080	0.110	2.04	2.79
S	0.045	0.055	1.15	1.39
T	0.235	0.255	5.97	6.47
U	0.000	0.050	0.00	1.27
V	0.045	—	1.15	—
Z	—	0.080	—	2.04

STYLE 1:  
 PIN 1. BASE  
 2. COLLECTOR  
 3. Emitter  
 4. COLLECTOR

CASE 221A-06  
 TO-220AB  
 ISSUE Y

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